Home Assignment 1 (Part 2)

due to October 15, 23:59

Your grade cannot be higher than 100. Soft deadline is due to October 13, 23:59 (+10% to your grade), hard deadline is due to October 18, 23:59 (-30% to your grade).

Problem 1. (30 points)

Open the file *"data_penalty_results.xslx"*. The file contains penalty results of team Tales against team Heads for several matches. In each episode, the goalkeeper of team Heads is Arkady Ivanov.

The table provides:

- Direction in which the ball was sent (right R or left L relative to the goalkeeper),
- Direction in which the goalkeeper jumped (right R or left L relative to the goalkeeper),
- Result of the episode (1 — goal scored, 0 — goal not scored).

a) Represent these interactions as a simultaneous game. For each penalty taker from team Tales, construct a payoff matrix. *Assume that the penalty taker's gain is the probability that the ball goes into the goal. Calculate this probability using the data provided in the table.*

b) Select two players from team Tales, find all Nash equilibria in pure and mixed strategies for selected matrices.

c) It is known that currently Arkady Ivanov chooses his jumping direction randomly with probability 1/2. What recommendation based on your research in b) would you give to the coach of team Heads regarding penalties against team Tales[1]?

You can solve this problem using Python, Excel or other tools that can help you[2]. With your answers you should provide your notebook or excel file.

Problem 2. (10 points) Open the file *"data_payoff_matrix.xslx"*. In the file, you will find the payoffs for the first and second player for different outcomes. Find all Nash equilibria in pure strategies.

You can solve this problem using Python, Excel or other tools that can help you[3]. With your answers you should provide your notebook or excel file.

Problem 3. (30 points) Give a real-life example of the two players dynamic game with a non-credible threat (or commitment)[4]. It is prohibited to use the examples provided by the link, the textbook indicated in the previous sentence and discussed at the seminar. Note that you should describe players, actions and their payoffs for all outcomes. Solve the game. Provide a way how player/players can make this commitment credible.

Problem 4. (30 points) Imagine a market for economics lessons. Inverse demand function is given by function $p = a - y$. There are 40 firms with zero marginal and zero fixed costs.

Interaction is arranged as follows:

- in the first period, firm 1 chooses how many lessons it will produce;

[1] Comment on optimality of current strategy.

[2] AI is still prohibited

[3] AI is still prohibited

[4] You can read more about credible commitment here Dixit, A. K., & Nalebuff, B. J. (1993). Thinking Strategically: The Competitive Edge in Business, Politics, and Everyday Life. W. W. Norton & Company New York London.

- in the second period the output of firms 1 is observed and firm 2 chooses how many lessons it will produce;
- in the third period the output of firms 1 and firm 2 is observed and firms 3 and 4 independently make their decisions about the output at the same time;
- in the fourth period everybody observe all outputs chosen previously by others and firm 5 chooses how many lessons it will produce;
- in the fifth period everybody observe all outputs chosen previously by others and firm 6 chooses how many lessons it will produce;
- in the sixth period everybody observe all outputs chosen previously by others and firms 7 and 8 independently make their decisions about the output at the same time;
- further, in every third period output is selected by two companies independently and simultaneously which is followed by two periods of single firm choice;
- so in period 30, firm 39 and firm 40 choose their outputs independently and simultaneously;
- then the price is set on the market, and all firms provide their lessons.

Find equilibrium outputs for each firm.